

### REMARKS

Claims 1-9 are pending in this application. Claims 5-9 have been withdrawn from consideration as a result of the restriction requirement being maintained.

The examiner has requested correction of the specification. Applicants have amended the specification in order to meet the requirements of MPEP §608.01(a) and 37 CFR 1.77, and therefore request the objection be withdrawn.

The examiner has also objected to claims 3, 4 and 7 under 37 CFR §1.75(c) as improper multi-dependent claims. However, applicants amended claims 3, 4 and 7 to eliminate the multiple dependency in the preliminary amendment filed with the application. Accordingly, applicants request the objection be withdrawn.

Claims 1-4 have been rejected under 35 USC §112, second paragraph, as indefinite for failing to particularly point out and distinctly claim the subject matter of the invention. However, the claims have been amended in order to meet the formal requirements of 35 USC §112. Accordingly applicants respectfully request the rejection be withdrawn.

Furthermore, the examiner has rejected claims 1-4 under 35 USC §103 as unpatentable over Chang (US 4,661,624). The examiner argues that the instant application differs from Chang in that Chang does not explicitly state that a TR:TA split is controlled as a function of alkali metal formate or alkaline earth metal formate content so that solid precipitates of alkali metal salts or alkaline earth metal salts are prevented. (Office Action of Sept. 10, 2003, page 9).

However, the examiner has failed to establish a *prima facie* case of obviousness with respect to the instant invention. Three requirements must be fulfilled in order for a *prima facie* case of obviousness to be satisfied. First, there must be some suggestion or motivation in the references themselves or available to one of ordinary skill in the art to modify the reference or to combine reference teachings.<sup>1</sup> Second, there must be a reasonable expectation of success. Third, the prior art references combined must teach or suggest all the claim limitations. MPEP §2143. Both the suggestion to carry out the claimed process and the reasonable expectation of success must be found in the prior art and not based on the applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438, 1442 (Fed. Cir. 1991). Additionally, the level of ordinary skill in the art cannot be relied upon to provide the suggestion to combine references. *Al-Site Corp. v. VSI Int'l Inc.* 174 F.3d 1308, 50 USPQ2d 1161, 1171 (Fed. Cir. 1999). With respect to the instant application the examiner has failed to meet this burden.

**1. A *prima facie* case of obviousness has not been established**

A *prima facie* case of obviousness has not been established because the reference lacks a suggestion or motivation to modify the reference to that of the instant invention. The process of the instant invention operates in a fundamentally different manner than that of Chang. Chang requires high concentrations of catalyst of 1.67 to

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<sup>1</sup>There are three possible sources for motivation to combine references: the nature of the problem to be solved, the teachings of the prior art, and the knowledge of persons of ordinary skill in the art. *In re Rouffet*, 149 F.3d 1350, 1357, 47 USPQ2d 1453, 1457-1458 (Fed. Cir. 1988).

12.79% by weight of the liquid reaction mixture (Col. 2, line 53; col. 3, line 47) in order to keep the concentration of formed methylformate in the effluent low. As a result of the low conversion of methylformate, salt deposits do not form but the content of methylformate in the reaction product is only 3.7 to about 19%, according to examples 1 and 3, or 3.7 to about 32% by weight (col. 2, lines 58-59). This also requires the continual addition to relatively large amounts of fresh catalyst to the process in order to maintain the high concentration of active catalyst required. Chang differs in a number of other aspects including, the reactor elements used, the pressure at which the process takes place and the molar ratio of carbon monoxide to methanol.

In contrast, the instant invention utilizes low concentrations of catalyst, 0.05 to 0.5% by weight of the liquid reaction mixture, in order to obtain a high concentration of methyl formate in the effluent from the reactor. (Applicant's specification p. 10). The process of the instant invention is set up in a cascade comprising at least two reactor elements at from 80 to 120°C, under a carbon monoxide pressure of from 90 to 180 bar, the molar ratio of carbon monoxide to methanol being set from 3:1 to 0.5:1. At least this amount of methanol remains unreacted in order to keep the catalyst and its degradation products virtually completely dissolved under the reaction conditions in the reactor and in the fresh reaction product.

The total output from the reactor, which contains a relative high proportion of from 60 to 95% by weight (page 14, line 16) of methyl formate is passed to a distillation apparatus in which essentially the methyl formate is stripped from the reaction mixture,

a part TR of from 80 to 20% of the remaining liquid phase is recirculated to the reactor and a part TA of from 20 to 80% of said liquid phase is discharged, and the residual catalyst and catalyst degradation products are removed solids free from the discharged part in a desalting apparatus. The remaining methanol is returned directly or indirectly to the reactor. (Page 12, lines 13-17). In conclusion, Chang differs from that of the instant invention because it utilizes comparatively high concentrations of basic catalyst, sodium methylate, to keep the concentration of formed methylformate in the effluent low. Col. 2, lines 20-21, lines 28-30 and line 53; col. 3, lines 16-18). The present invention utilizes only about 1/25 to 1/33 of Chang's amount of catalyst in order to obtain a high concentration of methyl formate in the effluent from the reactor. Accordingly, Chang cannot provide a suggestion to modify a process to that of the instant invention because it differs fundamentally in its operation. Therefore, applicants respectfully request the rejection be withdrawn.

**2. Secondary considerations have overcome a *Prima facie* case of obviousness**

Even if a prima facie case of obviousness has been established, applicants have overcome this burden with a showing of unexpected improvements. Proof of an unexpected improvement may rebut a *prima facie* case of obviousness. *In re Murch*, 464 F.2d 1051, 175 USPQ 89 (CCPA 1972). Indeed, it is always error to exclude evidence of secondary indicators. *Stratoflex v. Aeroquip Corp.*, 713 F.2d 1540, 218

USPQ 871 (Fed. Cir. 1983). The instant invention provides a number of surprising results.

First, the instant invention is capable of high conversion rates of methanol and CO and a high methyl formate concentration in the effluent of the reactor. The conversion in the reaction can be controlled both via the position of the thermodynamic equilibrium, which is influenced by adjustment of pressure and temperature, and via the stoichiometry and/or residence time of the reactants in the reactor. The great flexibility of the process of the present invention enables one to change the reaction conditions in order to set a particular desired quality of the end product or of the desired methanol and CO conversion. (Specification p. 20, lines 6-12).

In the present process the methanol conversion can be made significantly higher than in the process of Chang and therefore the amount of methanol to be circulated is considerably smaller. (Specification p. 20, lines 15-18). Additionally, the higher amount of methanol which has to be circulated in Chang's process results in a significant decrease in the space-time-yield.

A further advantage of the instant invention is that little to no recirculation of CO is necessary due to the high CO conversion of up to 97%. In contrast, Chang discloses a CO conversion of 88%. (Chang Example 1). Eliminating this recirculation reduces capital and energy costs for compressors or in the very least requiring a minimum of compression work. However, CO conversion may be controlled to a lower level if CO containing gas mixtures are used and/or a follow-up process, as e.g. methanol

synthesis is to be linked. (Specification p. 18, lines 1-28; p.19, lines 1-3).

Second, the instant invention has the added advantage of a slower rate of catalyst consumption. (Applicants specification p. 19, lines 7-20). In the production of methyl formate by reacting CO with methanol in the presence of a basic catalyst, the catalyst is converted into catalytically inactive substances by several unavoidable secondary reactions. Examples of these side reactions include: traces of water forming alkali metal hydroxide or alkaline earth metal hydroxide, traces of CO<sub>2</sub> leading to the formation of carbonates, reaction of the alkoxide with the methyl formate produced leads to alkali metal formate or alkaline earth metal formate, the direct reaction of alkali metal hydroxides and alkaline earth metal hydroxides with carbon monoxide also forms alkali metal formates or alkaline earth metal formates as by-products and the reaction of alkali alkoxide with methylformate also results in the formation of alkali formate. As a consequence of the high catalyst consumption and the high concentration of active catalyst required, it is necessary to continually add relatively large amounts of fresh catalyst to the process described in Chang. (Chang col. 5, lines 5-10).

Third, the instant invention has the added advantage of solids-free desalting. With this desalting process a defined amount of hot water or water vapor is introduced into the methanolic catalyst solution escaping from the stripping apparatus. Thus the methanol is vaporized and an aqueous solution of the inorganic salts is obtained. The vaporized methanol, after condensation and optionally addition of replenishment fresh catalyst, is recirculated into the reactors and the aqueous salt solution can easily be



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handled when it is legally disposed of. This way troublesome treatment of the salt containing effluents by methods of solids handling technology, e.g. by filtration or centrifugation is avoided. It is surprising that the methyl formate synthesis according to the present invention can be combined with said desalting process because in the case of known low-pressure and intermediate-pressure processes in which catalyst recirculation is necessary, it was central teaching that the introduction of water into the circuit is strictly avoided because the catalyst is destroyed by water. (Specification p.21, lines 6-10).

The process of the present invention allows the production of methyl formation from methanol and CO without the formation of salt precipitates inside the reactor and the work-up equipment so that blockage problems are eliminated. The availability of the plant and thus the annual capacity is considerably increased and a high space-time yield of from 400 to 1000 kg/m<sup>3</sup>/h is obtained.

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Respectfully submitted,

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